# TRACING HEREDITY BY MEANS OF BLOOD CRYSTALS

Dr. Edward T. Reichert.

## Prof. Reichert's Researches Supply Proof of Theory of Evolution and Contradict Some of the Classifications of Natural History

WITH the publication of the second work by Prof. Edward Tyson Reichert of the University of Pennsylvania describing his physiological investigations there remains but one other theory to be developed by him and that is that heredity can be traced through the examination of the blood crystals.

For years Dr. Reichert has been working to establish this theory. He has slowly been trying to discover whether it was not possible to determine the father of a child by comparing the blood crystals of the infant with those of the parent, and his work has progressed so far that he admits now that he has practically solved this question, but his laboratory work has not yet reached that point where he can give the results of his discoveries to the public.

"All that you can say for me," said Prof. Reichert to THE SUN correspondent in Philadelphia, "is that my work on heredity is progressing. Within the next year I will have established proof, I believe, that heredity can be traced through the blood crystals. When that is done I will have finished years of seemingly endless labor and I have enjoyed the work."

The two works which the Carnegie Institution at Washington has published represented the labor of the best years of the life of this man of science. As the head of the department of physiology at the University of Pennsylvania for the past twenty years Dr. Reichert has been more than a teacher or scholar. When not in the classroom he has been at work in his laboratory leading the way in new discoveries.

Physiologists knew in a general way the principles of life. They knew how the plant and the animal started existence, but they did not know what relation each species or each generation had to others. They knew in a general way, as Darwin had suggested, that man was related to the ape, but Darwin could not prove his theory because science in his day was not far enough advanced.

Scientists believed that the blood of all Germans should be alike and that it ought to be possible to distinguish between the blood of a Chinaman and the blood of an Englishman, but no one had demonstrated the fact that it was possible to differentiate between them.

Two years ago Dr. Reichert published through the Carnegie Institution the results of his first research work on the hemoglobin crystals. He found then that the blood crystals from six species of baboons resembled the blood crystals of a negro and when he completed that series of tests he found that he was nearer absolute proof of the theory of evolution than say other scientist had ever been.

It was not near enough, however, and Dr. Reichert realized that if he was to prove the relationship of man to the lower animals or if he was to supply proof of heredity through the blood he would have to begin at the beginning and study and analyze the chemistry of the forces which produce life. For this reason Dr. Reichert stopped his work on blood temporarily and devoted two years to research work among the starches so as to get back to biology and understand the forces that produce life.

The second work which has just been issued by the Carnegie Institution gives the results of that investigation. Marvellous as it may seem Dr. Reichert has traced the foundation of the genera of plant life and through studying the vegetable kingdom he has established rules for the determination of the relationship of all forms of animal and vegetable life. Seated at his desk in the laboratory of the University, Dr. Reichert said:

"When I had completed my work on hemoglobins I found that I had gone about as far as I could at that time and before it would be possible for me to continue my research work along the lines of evolution it would be necessary first for me to go back to the chemistry of protoplasm, and that meant that I had to work in the vegetable kingdom as well as the animal kingdom before I could find out where we were starting from."

In order to describe just what this substance is, Dr. Reichert explained some of the definitions of animal and vegetable life. He said that all living matter contained hydrogen, oxygen, sulphur, chlorine, fluorine, nitrogen, phosphorus, carbon, silicon, potassium, sodium, calcium, magnesium and iron. The abstraction of one of these elments meant death to the organism. The compounds occurring in living matter may be isolated in the laboratory but they do not then exhibit the properties of animate matter.

In the living cell the smallest particles of matter are arranged in such a manner that the phenomena of life are possible. Such an arrangement of materials is called protoplasm and anything which disturbs this arrangement results in sickness or death. From the chemical changes, the physical activities, that is, the motions characteristic of life result, or as Dr. Reichert put it: "The chemistry of protoplasm is the cornerstone of biology."

Heretofore the sum of the knowledge which science has had of the properties of living matter was derived from the study of physiology. Since research work has advanced it has become possible to ascertain the course from which all life springs, that is the chemistry of the forces which produce life, and it was to this phase of science that Dr. Reichert turned his attention, for if he was ever to substantiate his theories of the genera and species he must study the chemistry of protoplasm to find out whether all plant and animal life was formed of the same substance and had the same peculiarities.

Dr. Reichert believed that the active substance of which all living things are composed was not fundamentally alike in structure in all cases. Formerly physiologists believed that it was. To ascertain the truth, a long and arduous research was begun and at the conclusion, he was able to state definitely that there were so many variations that he could distinguish positively between the different species by tracing plants and animals back to their protoplasm.

It was also discovered that plants instead of having but few variations in their organic life, exhibited a greater degree of specialization in form and function than was generally supposed and that owing to this fact the plant cell was able to construct its protoplasm with the aid of solar energy from very simple forms of inorganic matter.

All this enabled the physiologist to study the starch grains from an entirely new angle. Previous investigators had found that starch grains exist in a considerable variety of forms, but that while the histological peculiarities of a given starch my sometimes be characteristic of the species, the genus or the family, they had never been able to depend on this for the determination of the species to which the plants belonged.

Dr. Reichert began at the very root of the first organism of life and he ascertained that starches from different plants varied in their physical and physio-chemical properties and that the differences are distinctive of the plants and could be plotted out or drawn in the form of reaction curves, which give pictures, as it were, by which he could distinguish immediately the genus, species and family to which a plant belongs.

In other words the reaction curve or picture of the starch from sorghum is entirely different from the picture of starch from barley. Starch from rye is entirely different from the starch from oats and so on. For more than two years Dr. Reichert studied over the microscope and drew the curves which supply the proof that science has progressed so far that one can tell now to what family a vegetable belongs by studying the characteristic features of its protoplasm. Two plants are now as readily distinguishable by their protoplasm as two human beings are by their photographs.

But this was merely the beginning of the work. Many complex organic substances were found in the make up of the elements which were isolated. More than 1,200 plants were examined and as a conclusion Dr. Reichert has proved to the satisfaction of the scientific world something that it never knew before. That is, the differences in the properties of the starches, proteins, glycogens and fats constitute a strictly scientific basis for the classification of plants and animals and that through them it is possible to distinguish the physiological properties of protoplasm which have their expression in heredity, variations, infections, sex formations and a host of problems of general and medical biology.

When he had completed this work Dr. Reichert again turned his attention to his hemoglobin tests and he ascertained that the same curves or pictures which he made of the protoplasm of plants could be followed when he examined the blood crystals of mammals. By the study of the crystallography of 107 different kinds of animals he has been able to determine through their blood the species to which they really belong. In some cases this produced a classification different from that made by the old methods.

By this new method a scientist can tell at once to what species of animal, bird or reptile any given specimen of blood belongs. This is because the blood of every species, Dr. Reichert says, crystallizes in a form of its own.

When it is considered that these blood crystals are 1-2250th of an inch in length and 1-9000th of an inch in breadth the nature of the work of the scientist will be appreciated. Dr. Reichert has studied not only the shapes of these crystals but also the relation that their angles bear to each other.

The discovery is of deep importance in natural history. By the new method a comparison of the blood crystals proves conclusively that the naturalists were mistaken in many of their classifications, as for example: the bear is related to the sea lion and the seal and not to the dog, the wolf or the fox, as was generally supposed.

The same principle applies to birds, and Dr. Reichert found that the guinea hen is not related to the same family as the chicken, as used to be the belief, but that its blood crystals were exactly like those of the ostrich. So on through natural history he used his discovery and reclassified 107 species of mammals, birds and fishes.

After this was demonstrated it was easy to make a practical application of this knowledge to medico-legal practice. Its value in relation to murder trials is obvious. For instance, it is now possible to tell with absolute certainty from what animal came the blood which made the stains on the garments of an accused person.

Many scientists have experimented with blood crystals, but it remained for Dr. Reichert to discover that the blood of every species of living creature crystallizes in a distinct and recognizable form of its own. He had to adopt very delicate methods in his experiments, one reason was that often he was able to get only a very small quantity of blood and he had to insure the crystals forming with the greatest ease and rapidity.

The method he employed was to take the blood and add a little oxalate of ammonium to it to prevent coagulation. He then shook it up very thoroughly with ether to free the hemoglobin from the corpuscles which it contained. The ether was then carefully separated from the rest of the blood mixture and a few drops of it was put on a microscopic slide, covered with a cover slip and the edges sealed with balsam. Gradually the crystals appeared and they were photographed in the usual way.

With this series of experiments completed Dr. Reichert has made it possible to distinguish between the blood of animals which have no relationship. There remains but one thing for him to do and that is to demonstrate that there is an individuality about every human being which distinguishes him, or her, from every other human being.

Reasoning on these lines it requires no great imagination to foresee the possibility that science will show that heredity is stamped with an indelible imprint on the life and body of every infant that is born to the human race.

# MEMORIAL TO BEECHER IN BROOKLYN

## Centenary of Preacher's Birthday, June 14, Attracts Attention to John Arbuckle's Gift to City and Plymouth Church.

SPECIAL interest is manifested at this time in the Beecher Memorial in Brooklyn on account of the centenary of the birth of Henry Ward Beecher, which occurs on June 14. This memorial owes its origin to the coffee merchant John Arbuckle, who a short time before his death took up the project of making some contribution to his city, and in particular to the part of it in which he lived, Columbia Heights. He abandoned the idea of an educational institution because Pratt Institute was already flourishing, and he refused to join in the plans for the extension of the Young Women's Christian Association because he did not approve of keeping young men and women apart.

It remained for the pastor of Plymouth Church, the Rev. Newell Dwight Hillis, to determine the half formed plans of Mr. Arbuckle by means of a Sunday morning sermon. In it Dr. Hillis called attention to the needs of the hundreds of young men and women living in hall rooms of the boarding houses on the Heights, many of whom were strangers in the city, and all of whom were intent on making their way in the world.

At once the coffee merchant conceived the idea of a building devoted to the needs of the young working people of the Heights—a building that would contain a club room, a library and a writing room, a gymnasium with a swimming pool and classrooms for giving instruction in such things as stenography, bookkeeping, dressmaking, millinery and kindergarten work. This idea became something more definite through the work of Woodruff L. Leming who completed a preparatory sketch of the building just a few months before Mr. Arbuckle died. The plans were revised and completed by Mr. Arbuckle's relatives after his death until finally the structure now under construction represents largely the ideas of his nephews, William A. Jamison and Charles Jamison.

Inasmuch as Mr. Arbuckle was an enthusiastic admirer of Henry Ward Beecher, contributing the first $5,000 to the Beecher fund and helping to raise the other $60,000, and inasmuch as the special objects of his interest were not only Columbia Heights but also Plymouth Church and its pastor, the approaching Beecher centennial seemed the very occasion for presenting to the city and to Plymouth Church the gift of the Arbuckle memorial. Therefore, above the mantelpiece in the reception room there will appear this inscription:

Presented to Plymouth Church
and
The People of Brooklyn
in recognition of
Henry Ward Beecher
and what he did to
Save the Union

Accordingly, the building will be known more commonly as the Beecher Memorial.

This memorial will be more than the institution originally planned, however. It will be a museum as far as possible and in it will be gathered the relics of the preacher. Perhaps the most interesting among these will be the old pulpit and chair which Beecher used from 1849 to 1869. Until recently the chair was lent to the Brooklyn Museum of Arts and Sciences by its owner, Stephen M. Griswold, who took great pains in restoring it, and who said of it: "I have no doubt that in time the Beecher chair will be quite as famous as the chair which was part of the furniture in the church where John Wesley preached, and which is now one of the priceless possessions of the British Museum."

Mr. Beecher's collection of old prints and his library will be restored as completely as possible, and valuable manuscripts will also be brought together. There are hundreds of other articles of interest in the life of Beecher at Plymouth, which are for the most part in the possession of his children. Some of these relics, such as the pulpit, chair, pictures and documents of historical interest, are already on exhibition in the lecture room of Plymouth.

The memorial will also be the last resting place of the bodies of Henry Ward Beecher and his wife. They will be brought from Greenwood Cemetery and placed in a crypt built into the wall of the church.

The memorial building is located west of Plymouth Church, on Hicks street, and it faces a little park 100 feet square, that being the land between it and the church. Within the park will be placed a Beecher statue. Gutzon Borglum, the sculptor, is now at work upon the model. It represents Mr. Beecher standing with outstretched hand in the act of selling two slave girls. At his left are the two girls, the older one seated and looking appealingly up at him, and the younger one with her head in her sister's lap.

The cost of establishing this tribute to the memory of Henry Ward Beecher, together with the cost of maintaining it, is estimated at $250,000. The Arbuckle gift alone amounts to $100,000. As early as 1903 a movement was begun to raise the necessary fund, a committee was formed, and in February of that year a circular letter was sent out to distinguished men of this country and abroad.

Although the 100th anniversary of Beecher's birth is on June 14, the formal exercises attending the Beecher centenary will not take place until the last week in October, when operations will be entirely completed. The services will extend for eight days from Sunday, October 26, through the following Sunday, November 2.